

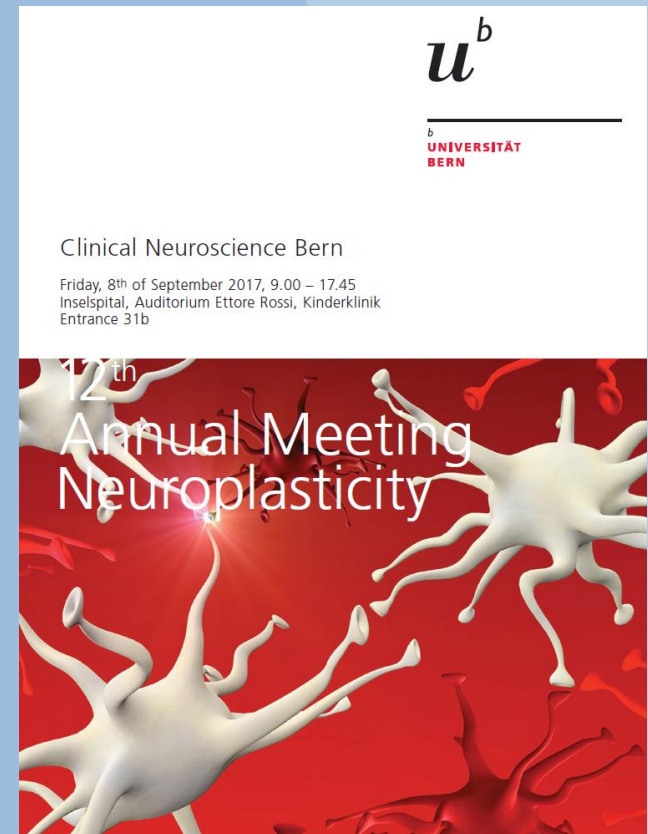
Clinical Neuroscience Bern

12th Annual Meeting, September 8, 2017

Bilateral temporal tDCS enhances sleep-dependent episodic memory consolidation

Matthias Grieder, Sarah Mueller, Stephanie Winkelbeiner, and Thomas Dierks

Division of Systems Neuroscience of
Psychopathology
Translational Research Center
University Hospital of Psychiatry Bern



Background: **Rationale**

»The relationship between sleep disorders and neurological disorders is often reciprocal, such that sleep disorders are worsened by neurological symptoms and that neurological disorders are aggravated by poor sleep.«

Ebajemito, J. K., et al. (2016). Frontiers in Neurology, 7, 54.

Background: Promising Results

The Journal of Neuroscience, November 3, 2004 • 24(44):9985–9992 • 9985

Behavioral/Systems/Cognitive

Transcranial Direct Current Stimulation during Sleep Improves Declarative Memory

Lisa Marshall, Matthias Mölle, Manfred Hallschmid, and Jan Born
Institute of Neuroendocrinology H23a, University of Lübeck, 23538 Lübeck, Germany

Background: Promising Results

nature

Vol 444 | 30 November 2006 | doi:10.1038/nature05278

LETTERS

Boosting slow oscillations during sleep potentiates memory

Lisa Marshall¹, Halla Helgadóttir¹, Matthias Mölle¹ & Jan Born¹

Background: Promising Results

The Journal of Neuroscience, July 26, 2017 • 37(30):7111–7124 • 7111

Behavioral/Cognitive

Promoting Sleep Oscillations and Their Functional Coupling by Transcranial Stimulation **Enhances Memory Consolidation** in Mild Cognitive Impairment

Julia Ladenbauer,^{1,2,3*} Josef Ladenbauer,^{4,5,6*} Nadine Külzow,^{1,2} Rebecca de Boor,¹ Elena Avramova,¹ Ulrike Grittner,⁷ and Agnes Flöel^{1,2,3}

¹Department of Neurology and ²NeuroCure Cluster of Excellence, Charité Universitätsmedizin Berlin, 10117 Berlin, Germany, ³Department of Neurology, Universitätsmedizin Greifswald, 17475 Greifswald, Germany, ⁴Department of Software Engineering and Theoretical Computer Science, Technische Universität Berlin, 10587 Berlin, Germany, ⁵Bernstein Center for Computational Neuroscience Berlin, 10115 Berlin, Germany, ⁶Group for Neural Theory, Laboratoire de Neurosciences Cognitives, École Normale Supérieure, 75005 Paris, France, and ⁷Biostatistics and Clinical Epidemiology, Charité Universitätsmedizin Berlin, 10117 Berlin, Germany

Background: Disillusioning Results

Behavioral Neuroscience
2017, Vol. 131, No. 4, 277–288

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0735-7044/17/\$12.00 <http://dx.doi.org/10.1037/bne0000202>

REPLICATION

No Evidence for Enhancements to Visual Working Memory With Transcranial Direct Current Stimulation to Prefrontal or Posterior Parietal Cortices

Matthew K. Robison, William P. McGuirk, and Nash Unsworth
University of Oregon

Background: Disillusioning Results

Brain Stimulation 9 (2016) 730–739



Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: www.brainstimjrnl.com



Boosting Slow Oscillatory Activity Using tDCS during Early Nocturnal Slow Wave Sleep **Does Not Improve** Memory Consolidation in Healthy Older Adults



Sven Paßmann^{a,b,*}, Nadine Külzow^{a,b}, Julia Ladenbauer^{a,b}, Daria Antonenko^{a,b},
Ulrike Grittner^{c,d}, Sascha Tamm^e, Agnes Flöel^{a,b,d,**}

^a Department of Neurology, Charité University Hospital Berlin, Charitéplatz 1, 10117 Berlin, Germany

^b NeuroCure Cluster of Excellence, Charité University Hospital Berlin, Charitéplatz 1, 10117 Berlin, Germany

^c Department for Biostatistics and Clinical Epidemiology, Charité University Hospital Berlin, Charitéplatz 1, 10117 Berlin, Germany

^d Center for Stroke Research, Charité University Hospital Berlin, Charitéplatz 1, 10117 Berlin, Germany

^e Department of Psychology, Free University Berlin, Habelschwerdter Alle 45, 14195 Germany

Background: Disillusioning Results

Brain Stimulation 10 (2017) 567–575



Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: <http://www.journals.elsevier.com/brain-stimulation>



A single session of prefrontal cortex transcranial direct current stimulation **does not modulate** implicit task sequence learning and consolidation



Branislav Savic^a, René Müri^b, Beat Meier^{a,*}

^a Institute of Psychology and Center for Cognition, Learning, and Memory, University of Bern, Switzerland

^b Department of Neurology, Bern University Hospital Inselspital, and Center for Cognition, Learning, and Memory, University of Bern, Bern, Switzerland

Background: Disillusioning Results

Brain Stimulation 8 (2015) 528–534



Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: www.brainstimjrnل.com



Oscillating Square Wave Transcranial Direct Current Stimulation (tDCS) Delivered During Slow Wave Sleep **Does Not Improve** Declarative Memory More Than Sham: A Randomized Sham Controlled Crossover Study



Gregory L. Sahlem^{a,*}, Bashar W. Badran^{a,d}, Jonathan J. Halford^b, Nolan R. Williams^{a,b}, Jeffrey E. Korte^c, Kimberly Leslie^a, Martha Strachan^a, Jesse L. Breedlove^d, Jennifer Runion^a, David L. Bachman^b, Thomas W. Uhde^a, Jeffery J. Borckardt^a, Mark S. George^{a,b,d,e}

^a Department of Psychiatry, Medical University of South Carolina, 67 President St., 502N, Charleston, SC 29425, USA

^b Department of Neurology, Medical University of South Carolina, 96 Jonathan Lucas St., CSB 301, Charleston, SC 29425, USA

^c Department of Public Health Sciences, Medical University of South Carolina, 135 Cannon Street Suite 303, MSC 835, Charleston, SC 29425-8350 USA

^d Department of Neurosciences, Medical University of South Carolina, 68 President St, BE 101, MSC 501, Charleston, SC 29425, USA

^e Ralph H. Johnson VA Medical Center, 109 Bee Street, Charleston, SC 29401, USA

Background: Disillusioning Results

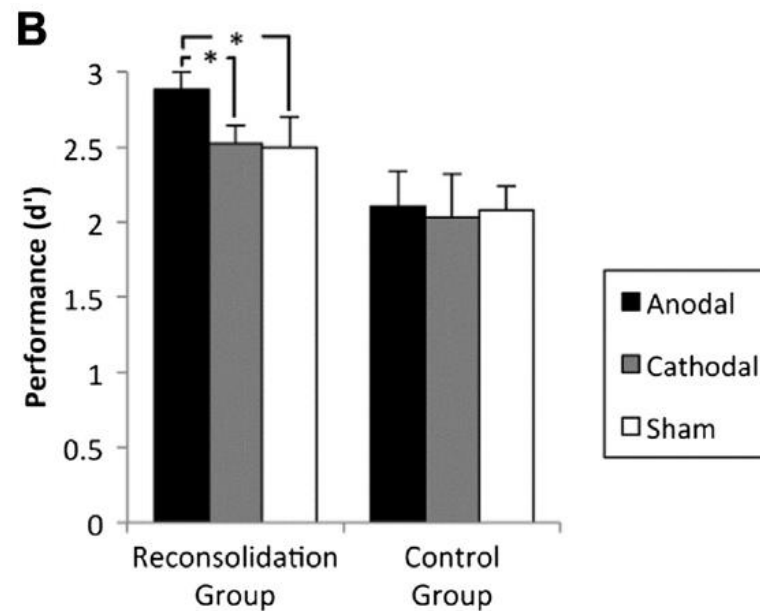
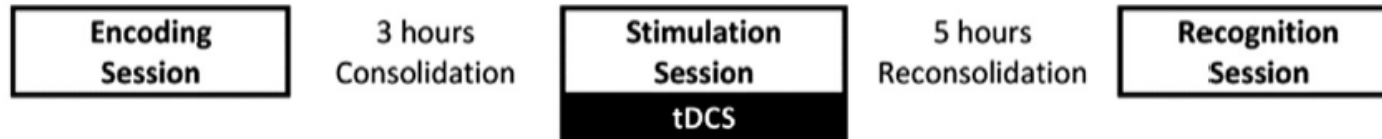


No Significant Effect of Prefrontal tDCS on Working Memory Performance in Older Adults

Jonna Nilsson, Alexander V. Lebedev and Martin Lövdén*

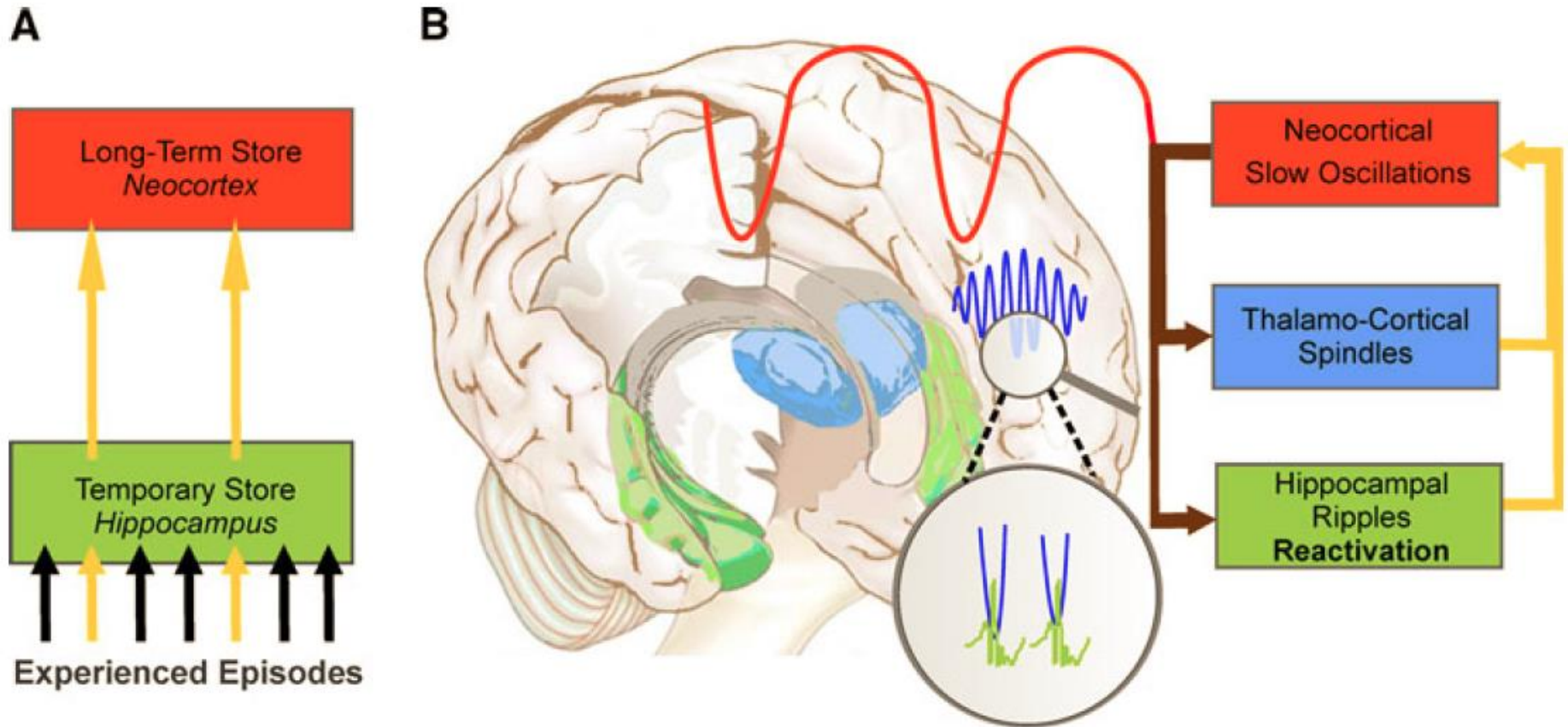
Aging Research Center, Karolinska Institutet and Stockholm University, Stockholm, Sweden

Background: tDCS and Memory Consolidation



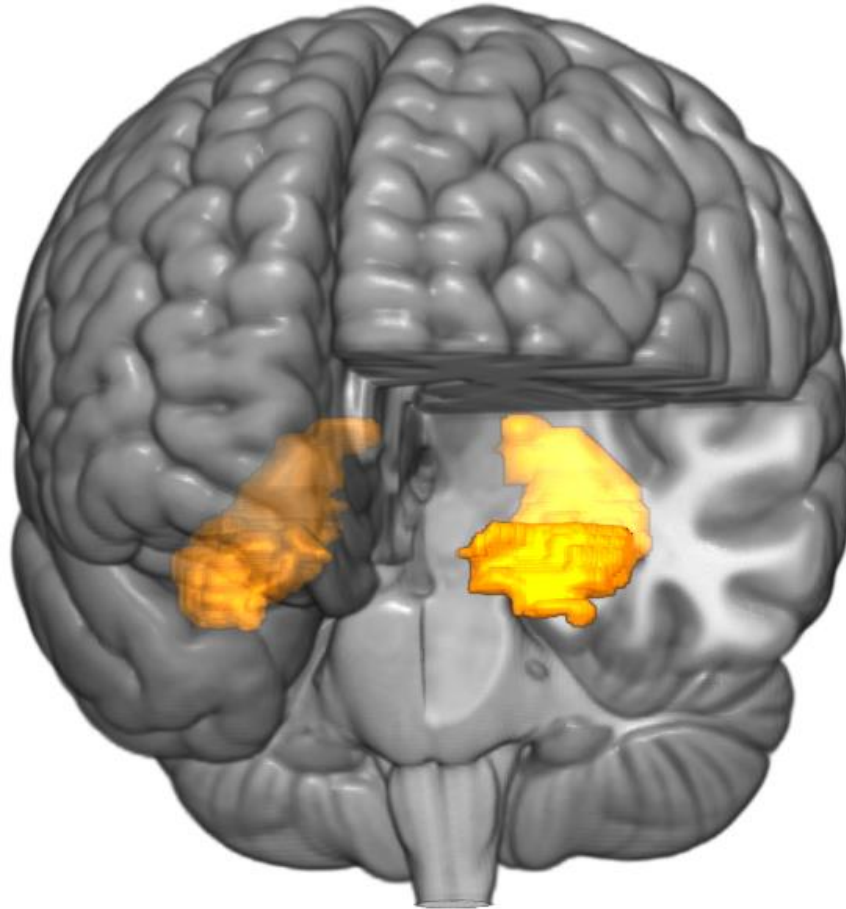
Javadi & Cheng (2013) *Brain Stim*

Methods: tDCS target region – Hippocampus



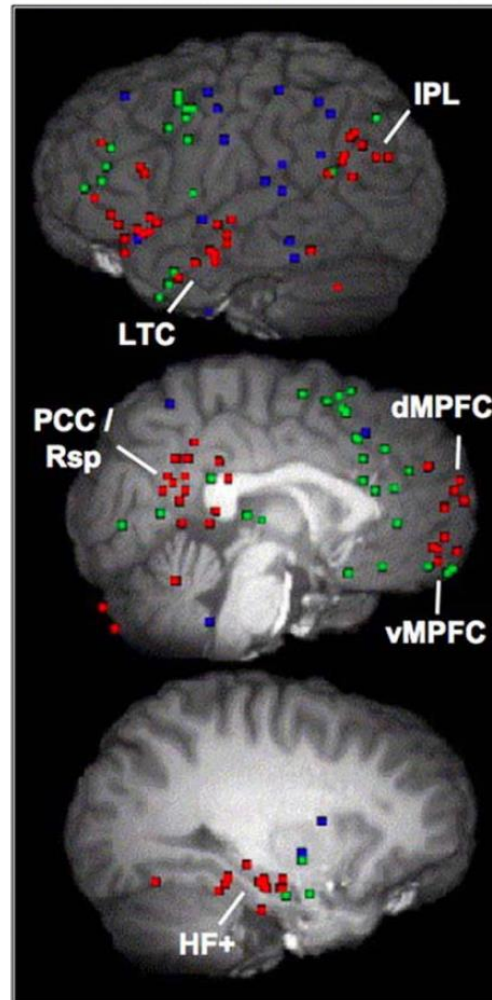
Born & Wilhelm (2012) *Psychol Res*

Methods: tDCS target region – Hippocampus



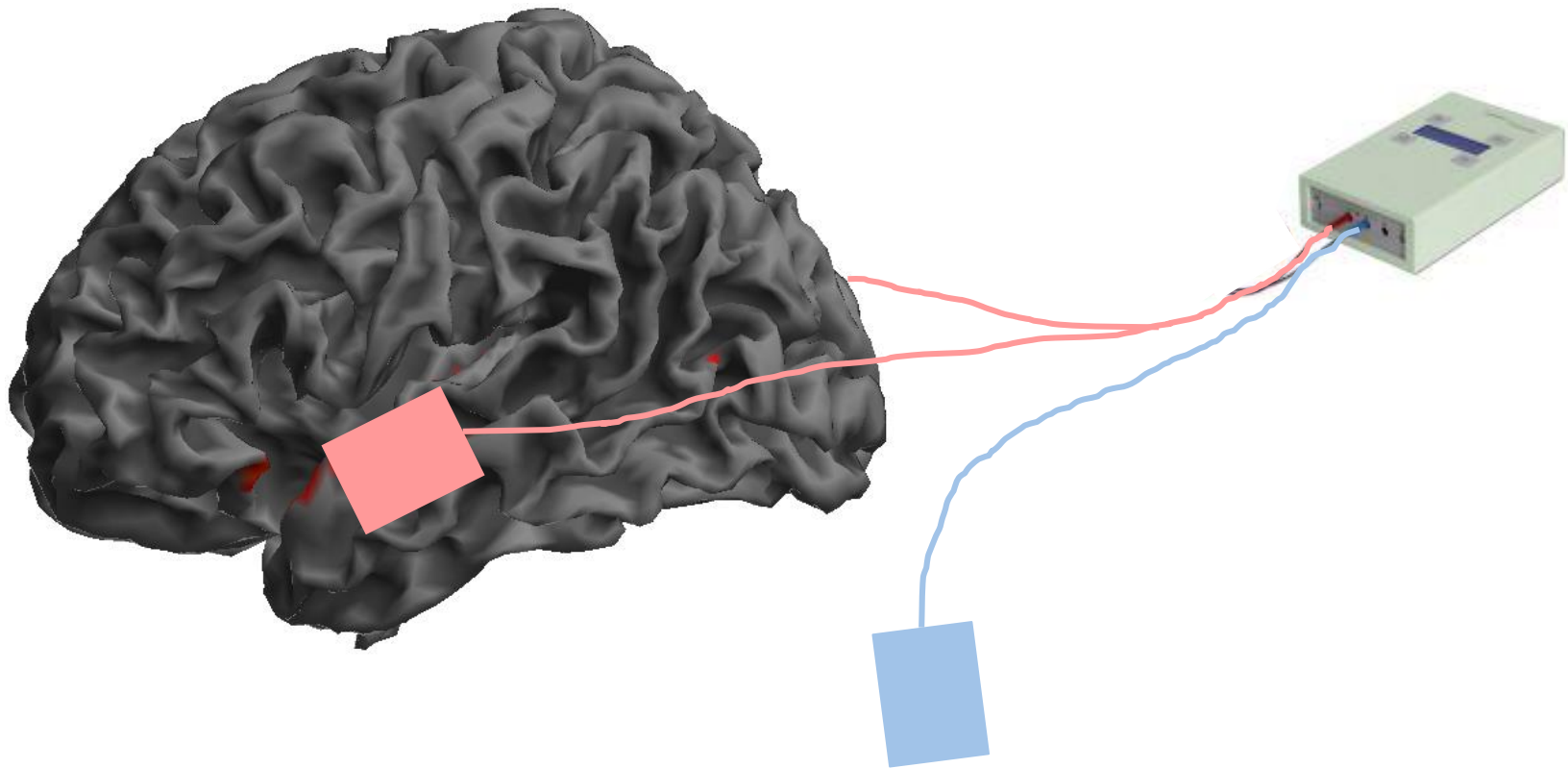
Methodological Challenge

AUTOBIOGRAPHICAL MEMORY

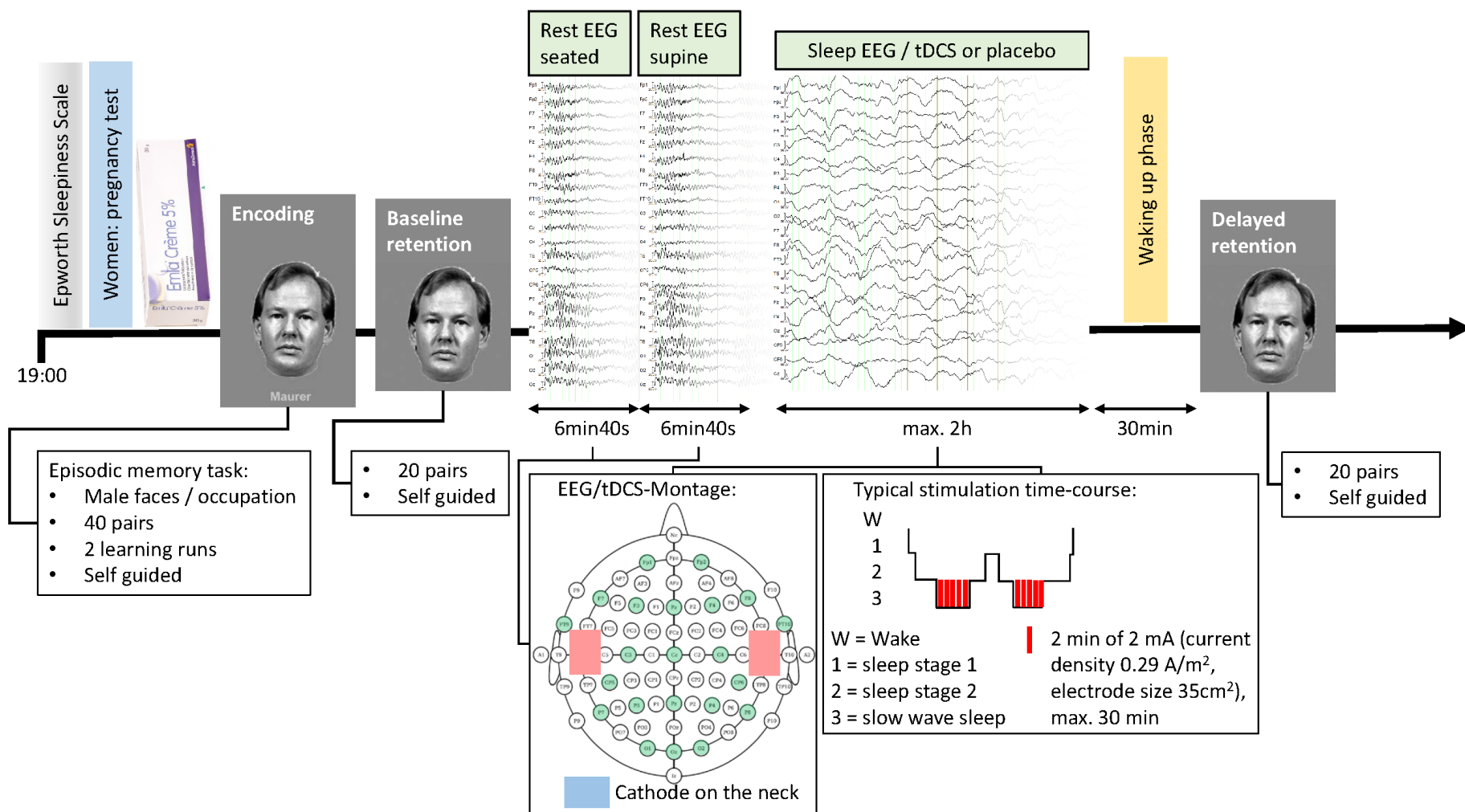


Monte-Silva et al. (2013)
Svoboda et al. (2006)

Methods: tDCS setup



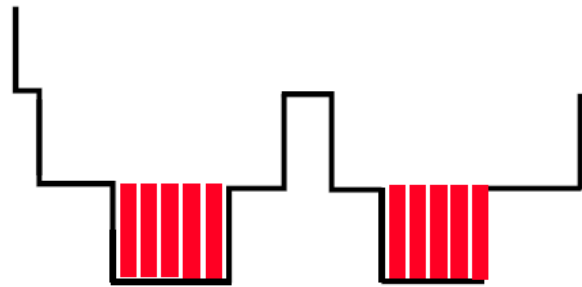
Methods: Experimental procedure



Methods: Experimental procedure

Typical stimulation time-course:

W
1
2
3

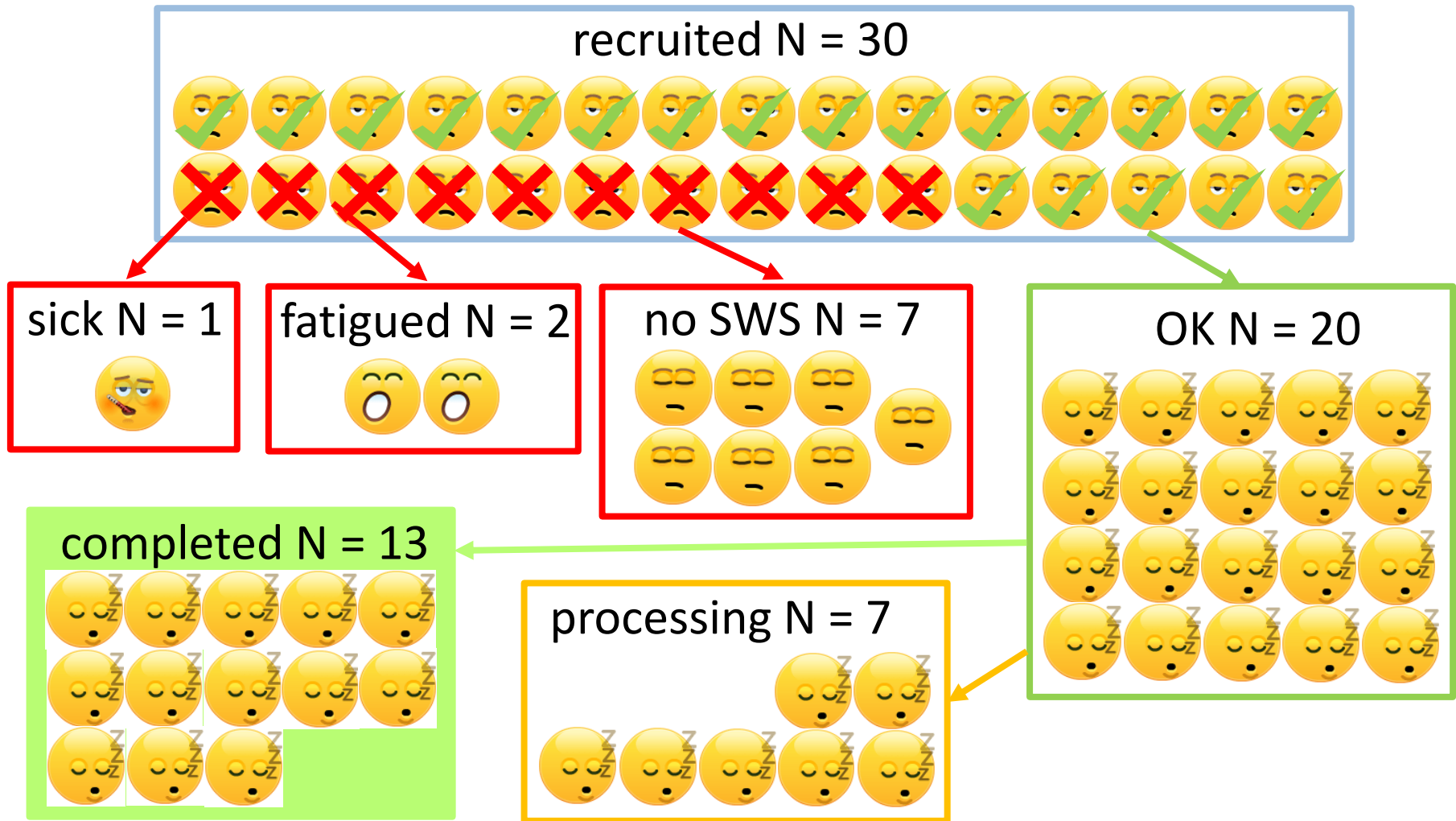


2 min of 2 mA (current density 0.29 A/m^2 , electrode size 35 cm^2), max. 30 min

Hypotheses

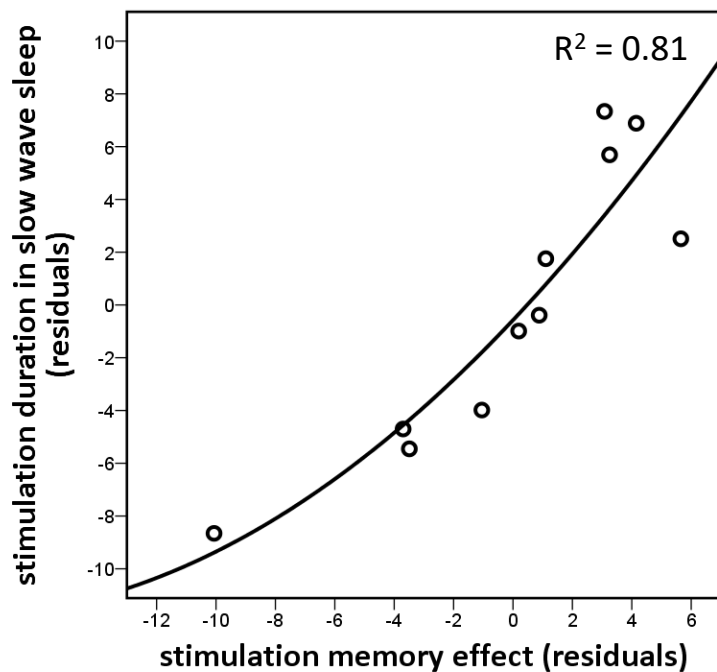
- > tDCS improves sleep-dependent memory consolidation as compared to placebo stimulation.
- > tDCS increases slow wave amplitudes as compared to placebo stimulation.

Current Data Situation



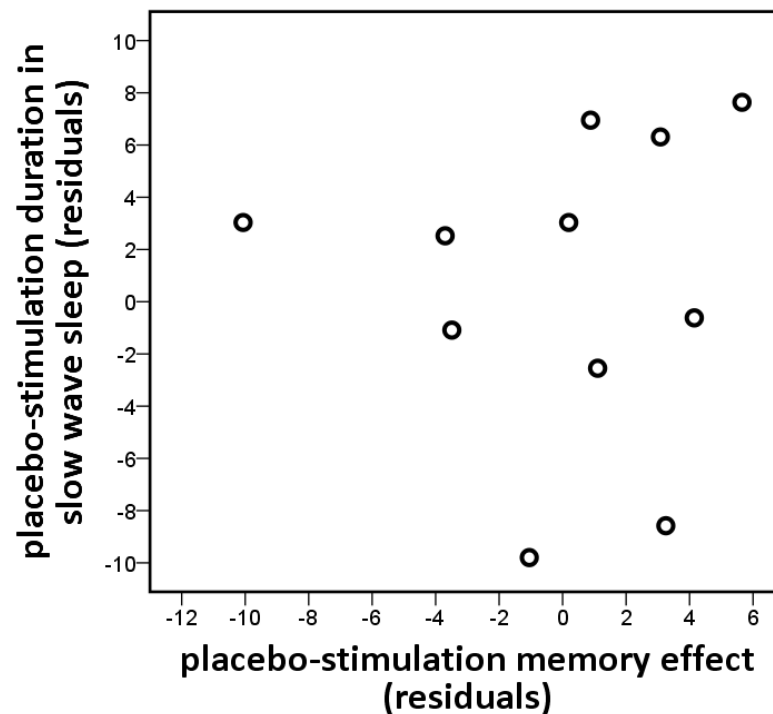
Results: tDCS and memory consolidation

Stimulation



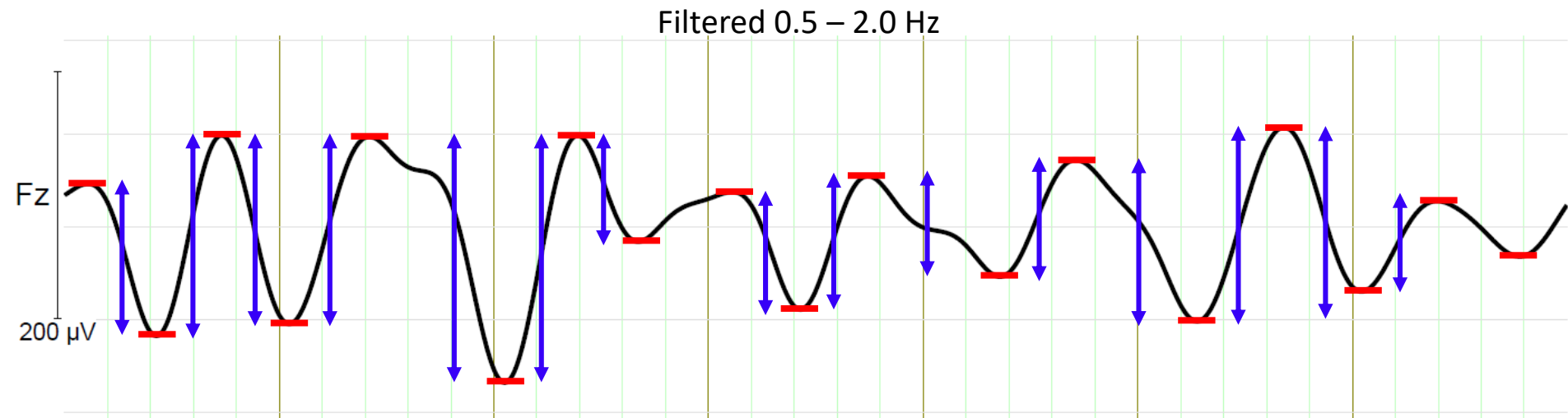
Pearson's $r = 0.89$, $p < 0.01$

Placebo-stimulation



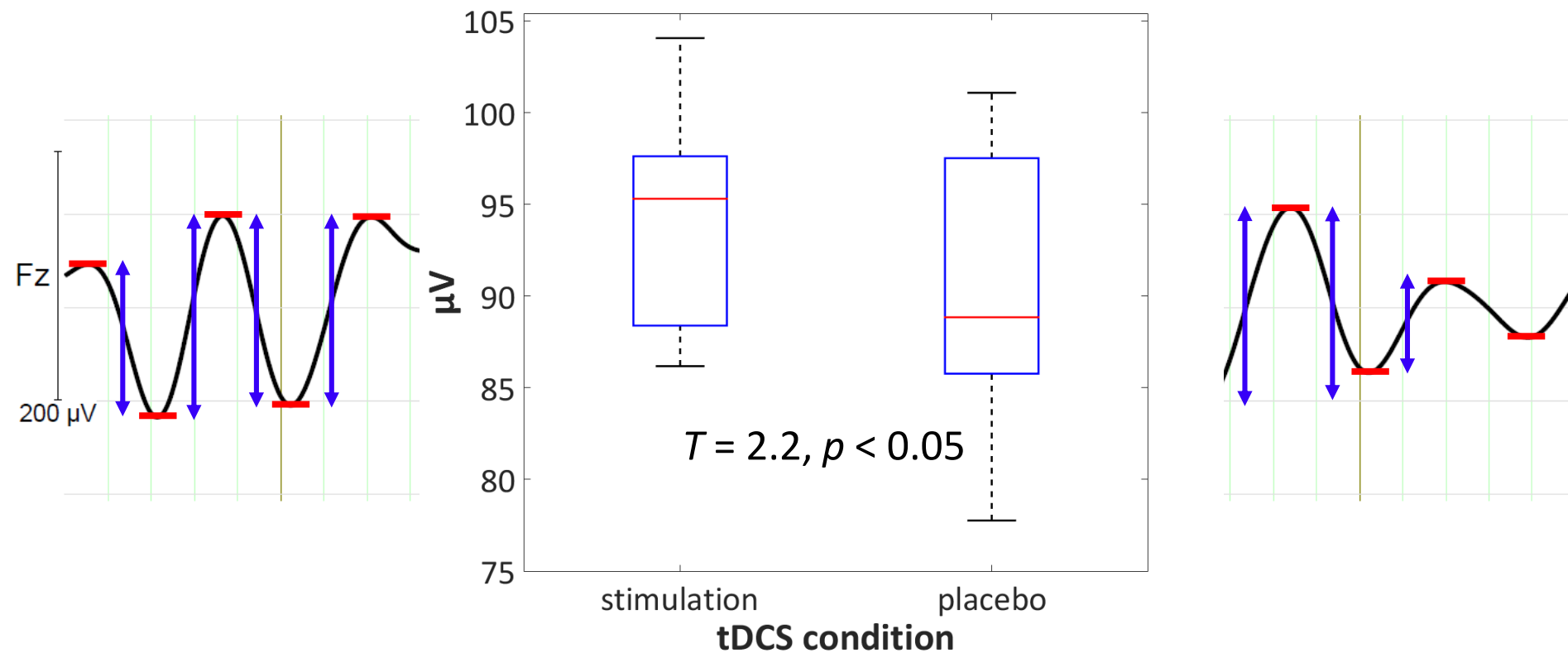
Pearson's $r = -0.22$, $p = 0.56$

Results: tDCS and slow waves



Results: tDCS and slow waves

Slow wave amplitudes



Discussion

- > tDCS during SWS can improve memory consolidation
 - The more SW are stimulated, the better the memory performance
- > Crucial factors that might influence effectiveness of tDCS:
 - Optimal timing of stimulation (Manenti et al., 2016, *Behav Brain Res*)
 - Evidence-guided electrode montage
- > Replication is needed
- > Classification of responders and non-responders

Acknowledgment



University Hospital of Psychiatry Bern

- Thomas Dierks
- Kristoffer Féher
- Thomas Koenig
- Yosuke Morishima
- Sarah Maria Müller
- Stefanie Verena Müller
- Werner Strik
- Stephanie Winkelbeiner



Department of Psychology

- Katharina Henke
- Simon Ruch

Department of Neurology

- Claudio Bassetti
- Johannes Mathis